WATER WASTE PREVENTION ON RAILROADS[1]

By C. R. Knowles[2]

In presenting this paper on the prevention of water waste on railroads, the author wishes to emphasize the fact that he does not appear merely as a consumer of water pointing out savings to be made only by reducing the quantity of water purchased but also as a producer of water with problems and troubles very like those of most water works officials. The sources of waste that may be enumerated and discussed at this time are as common to the supply furnished by a railroad company's pumps as to the supply purchased from a city water works plant.

The duties of a city water works manager and the duties of a superintendent of railway water service are along parallel lines, namely, the economical production of water adequate in quantity and satisfactory in quality. There is this difference, however, the manager of the private or municipal water works is in constant touch with his plant or plants and has direct supervision of their operation, while the plants on a railway system may be scattered over half a continent and are subject to the varying conditions peculiar to the territory in which they may be located. Consequently, some of the problems encountered in the prevention of water waste on railroads may be novel to the city water works man.

The author has been conducting a water waste campaign on the Illinois Central Railroad system for the past five years, endeavoring to impress upon officers and employes the value of water and the importance of water waste prevention. It is very gratifying to be able to report that this campaign has resulted in a material reduction in the waste and unnecessary use of water.

The total consumption of water on the Illinois Central system for the past five years, divided between water pumped by company

[1] Read before the Montreal Convention June 24, 1920. Discussions are invited and should be sent to the Editor.

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forces and water obtained from an outside supply, is shown in the following table:

YEAR	COMPANY PLANTS	OUTSIDE SUPPLY	TOTAL
	gallons	*gallons*	*gallons*
1915	15,300,000,000	2,986,000,000	18,286,000,000
1916	15,100,000,000	2,844,000,000	17,984,000,000
1917	14,000,000,000	2,754,000,000	16,754,000,000
1918	14,140,247,000	2,771,674,000	16,911,921,000
1919	12,967,260,000	2,655,740,000	15,622,000,000

It will be noticed that the consumption in 1919 was 2,664,000,000 gallons less than in 1915, while the average reduction for the five year period is 1,468,019,750 gallons. During the above mentioned period there was an increase of over 20 per cent in tonnage handled, which would indicate that a still greater reduction was made in the waste of water than is shown by above table.

The reduction in waste of water was accomplished by frequent water waste surveys at all points on the system, these water waste surveys varying from an investigation of a single hydrant at an outlying station requiring only ten or fifteen minutes time, to an investigation of the water supply at large terminals, sometimes requiring several days. As an example of conditions found in these water surveys a few instances may well be cited.

At a large Southern terminal a request had been made for authority for an expenditure of approximately $20,000 for new pumps and pipe lines, the request being based upon the assumption that the old pumps and pipe lines were too small to furnish sufficient water. A water waste survey disclosed the fact that 40 per cent of the water pumped was being wasted. When these conditions were corrected there was no difficulty in providing all the water required without any expenditure for additional equipment.

The consumption of water at a large office building used for general railway purposes had increased to approximately 8,000,000 gallons per month, and as this consumption appeared excessive, a water waste survey was made, with the result that the consumption was cut to approximately 2,000,000 gallons per month, a decrease of 75 per cent. The conditions at this point were due to general waste of water through almost every water facility in the building. For example, the controlling valves on the boiler feed water heater were

not operating properly, allowing unlimited quantities of water to pass through the heater to the bilge tanks where it was being pumped by an electric bilge pump to the sewer, this waste causing a threefold loss: First, the cost of furnishing the water; second, the loss of the coal required to heat the water which at the time the investigation was made was estimated to be the equivalent of 250 boiler horse power; third, an additional loss of electric current required to pump the water from the basement level to the city sewer, the bilge pump operating every 50 seconds at the time the investigation was made.

The urinal tanks, eighteen in number, were found to be flushing at intervals of from 50 seconds to 1 minute and 10 seconds. These tanks were of the 3-gallon flush type, probably 2,000,000 gallons of the water being used through these urinals. The controlling valves to the house tanks were in bad order, and the overflow from these tanks to the sewer was practically constant. In addition to these large wastes, there were a number of minor wastes of hot and cold water in the restaurant and other places in the building.

At a large engine terminal in the Middle West, the automatic valves controlling the water supplied to a large hot water boiler washing system were found inoperative, the consumption of water through the boiler washing system amounting to 300,000 gallons per day. Upon repairing and adjusting the valves the consumption decreased immediately and the daily consumption at the present time is approximately 60,000 gallons, a saving of 80 per cent of the water formerly used.

At another point the consumption was decreased nearly 3,000,000 gallons per month by adjusting and repairing automatic valves controlling water supplied to a boiler feed water heater and boiler washing system. In this particular instance the saving in heat applied to the water wasted was in excess of the cost of the water.

Numberless other instances could be cited where material economies in the use of water have been effected through these water waste surveys, those mentioned above being merely given as examples. The favorable results of the efforts towards prevention of water waste have not been easily obtained, as it is extremely difficult to convince the average railroad employe that he should exercise care in the use of water, for he cannot understand why one should worry about water with innumerable lakes and rivers on and adjoining the right-of-way. He cannot appreciate the fact that costly pumping

stations, reservoirs, water softening plants, storage tanks and pipe lines are necessary to deliver the water to the point of use.

The question has been raised, why the city water works manager should be interested in water waste prevention where the water was supplied through meter and the cost of such waste billed against the consumer.

In the first place it is to the interests of all public officers to prevent waste in any form, as their interests are not limited to the individual but to the community as a whole, and they recognize it as their duty to lead in campaigns for the elimination of all waste in all forms. The creation of waste benefits no one and adds nothing to the wealth of the country, institution or the individual. The city water works manager, realizing his duty to the public good in his efforts to eliminate waste, does not stop to question whether the waste goes to make up a part of his revenue or not. While there may be some few instances where a waste of water would increase the revenue of the water company without materially affecting the operation of the plant, unlicensed waste on the part of one consumer jeopardizes the supply to others and in justice to all, waste cannot be tolerated whether the waster pays for it or not. The water company cannot afford to encourage water waste, even by metered consumers, on account of the example set to those who are not metered and have no interest in keeping down the consumption. Excessive waste such as might occur with a large consumer such as a railroad company causes a great fluctuation in the demand. While a million gallons a day more or less would make but little difference with a plant pumping a hundred million gallons or so per day, it would create a serious condition with many smaller plants and doubtless in many places the correction of waste, leakage and unnecessary consumption would eliminate the necessity of expenditures for additional pumping equipment and distribution systems which is a serious matter under present material and labor conditions. This was appreciated by the Committee on War Burdens of the Water Works of the United States in its report in which it stated: "Pressure will doubtless be brought to bear to force communities to husband their water supply by reducing waste, leakage and even unnecessary consumption in order to curtail unnecessary investment in plants thus made necessary." While the above statement had direct reference to conditions arising from the world war, yet in a large measure they are just as true of conditions today.

The heavy migration to the cities in recent years has increased the urban population and the demand for water for domestic purposes to such an extent that many water plants are facing heavy expenditures for additional capacity at a time when it is extremely expensive and difficult to make such extensions. The reduction of waste will undoubtedly postpone these extensions until conditions return more nearly to normal.

A writer in *Engineering and Contracting* calls attention to the enormous waste of water by one of the largest cities in the world and goes on to show that the prevention of waste through installing meters at a cost of $13,000,000 would save an investment of $94,000,000 for additional equipment, not to mention a saving of $69,000,000 in coal, wages and repair.

As the equipment and appliances used in modern water works have increased in cost 50 to 300 per cent, there is no question that many water works plants are overworking their power houses to supply water to be wasted, and that many requests for appropriations are the direct result of waste beyond the control of the water works manager.

The annual consumption of water by the railroads of the United States is estimated at 900,000,000,000 gallons per year, 225,000,000,000 gallons of which is purchased from private or municipal water works plants and undoubtedly represents no inconsiderable portion of water pumped by these plants.

Many cities supply water at sliding rates, giving the large long hour consumer the benefit of the low rates. As the railways are such large consumers, the water which they waste is nearly all furnished at the lowest rates, which rates yield a comparatively small net profit to the Water Works Company. If this water was made available for distribution to a large number of small consumers the net revenue would be increased materially, thus benefiting both the railroad and the water company.

It has been estimated that 20 per cent of the water used on the railroads of the country is wasted. If this estimate is correct, we have 180,000,000,000 gallons of water pumped per year for no purpose other than to increase the expense of railroad operation and burden the pumping plants with an additional load. Using the figure of 25 pounds of coal for each 1000 gallons of water pumped, the waste requires the consumption of 2,250,000 tons of coal or more

than 6000 tons per day, and no doubt the part that this waste pays in the expense for additions to power and pumping equipment makes the coal bill look insignificant by comparison.

DISCUSSION

CHARLES HAYDOCK: The author has called attention to a very important use of water which all have not realized, and that is, the uses of the railways of the country.

For instance, on the Pennsylvania Railroad Lines East, there are about 87,000,000 gallons of water a day used for locomotive purposes alone. That does not include water which is used for coach washing, wetting down cinders, sanitary and domestic purposes in general. The quality of that water has not received the attention it warrants. A supply of pure, soft water is valuable for railroad uses because of necessity the steam locomotive operates uneconomically and the evaporation is at a rather high rate. The figures which the author has given would practically be substantiated by those on the Pennsylvania Railroad.

Water waste surveys on railroads probably pay just as well as in cities. In order to determine the uses of the Pennsylvania Railroad Company for locomotive purposes, as above noted, an investigation was made last fall. While this was not a water waste survey nor a campaign to reduce leakage, the information obtained during the investigation was sufficient to save its cost to the company many times over.

The greatest use is at yards and terminals, where lines and grades are subject to revision resulting in burying pipe under deep cover or exposure to attack by sulphur waters leached from cinders. Such conditions are favorable for excessive leakage unless the closest supervision is exercised, aided by suitable facilities for measuring the quantities used.